# Design for Interest: *Exploratory Study on a Distinct Positive Emotion in Human-Product Interaction*

**JungKyoon Yoon*, Pieter M. A. Desmet, and Aadjan van der Helm**

*Department of Industrial Design, Delft University of Technology, Delft, The Netherlands*

This study explored the possibilities to design interactions that evoke user interest. On the basis of appraisal theory, it was predicted that interest is evoked by a combined appraisal of novelty-complexity and coping potential. Because the role of novelty-complexity is well-documented (i.e. a product must be appraised as novel and/or complex to be interesting), the study focused on the role of coping potential: the degree to which one appraises oneself to have sufficient skills, knowledge, and resources to deal with an event. Two workshops investigated how the interest appraisal manifests in the context of human-product interaction in terms of appraisal questions and related product qualities. The findings were used to develop three prototypes of interactive music players. These were identical in terms of appearance, but different in terms of coping requirements during product use. The main study measured the appraisals and emotions of people using the prototypes, using both self-report and behavioral measures. The results indicated that along with novelty-complexity, a high level of appraised coping potential is necessary for experiencing interest. When coping potential was appraised as low, the respondents experienced negative emotions such as annoyance instead of interest.

***Keywords –*** Design for Emotion, Interest, Human-Product Interaction, Positive emotions.

***Relevance to Design Practice –*** The findings gained in this study can assist in the design of a product where the intention is to evoke interest in human-product interactions. They provide an understanding of how the general appraisal dimensions of novelty-complexity and coping potential can be made more specific for the domain of product experience.

***Citation:*** Yoon, J., Desmet, P. M. A., & van der Helm, A. (2012). Design for interest: Exploratory study on a distinct positive emotion in human-product interaction. *International Journal of Design,6*(2), 67-80.

## Introduction

When using products, we can experience all kinds of emotions. We can, for example, be inspired by the aesthetic appearance of a mobile phone, feel joy with a new toy, be content with the high-quality sound of a music player, or be delighted by an alarm clock sound (Desmet, 2008). Different eliciting conditions evoke these emotions and they also differ in how they influence our behavior and attitudes (Roseman & Smith, 2001). This applies to positive as much as to negative emotions. It has been shown that positive emotions like joy, contentment, love, interest, amusement and pride improve individual and collective functioning, psychological well-being and physical health (Fredrickson, 2003). Moreover, positive emotions alleviate stress and reduce the harmful effects of negative emotions (Fredrickson & Losada, 2005). For these reasons, it can be advantageous for designers to understand how distinct positive emotions are elicited and how these emotions affect usage behavior. By deliberately designing products to elicit distinct, predefined positive emotions, people can be supported in their efforts to use products. For instance, a product that evokes joy may stimulate playful interactions, a product that elicits interest may stimulate focused and explorative interaction and a product that evokes contentment may stimulate peaceful and reflective interactions.

Despite the beneficial effects of positive emotions, little viable knowledge is available to assist designers in their attempts to design interactions that evoke differentiated positive emotions. Traditionally, design research has focused on general pleasure or displeasure, ignoring the differences, both in eliciting conditions and manifestations between distinct positive emotions. Although general emotion theorists have studied these differences, their theories predominantly focus on negative emotions (Fredrickson, 1998, 2003). As a consequence, the roles of differentiated positive emotions in human-product interactions remain largely unrevealed.

The aim of the current study is to explore the possibility to design for a specific positive emotion. The emotion ‘interest’ (Scherer, 2005) was selected for several reasons. Firstly, interest is an emotion that is often experienced by product users (Desmet, 2002). Secondly, the experience of interest has a positive effect on general well-being (Richman, Kubzansky, Maselko, Kawach, Choo, & Bauer, 2005). Thirdly, interest is known to play a powerful role in the growth of knowledge and expertise (Silvia, 2008). Because little is known about how products evoke interest during product use, the study focused on interest

**Received** July 8, 2011; **Accepted** May 25, 2012; **Published** August 31, 2012.



****Corresponding Author:*** j.yoon@tudelft.nl

experienced during dynamic interaction. Hence, the overall question addressed in this paper is: how to design an interaction that evokes an experience of interest?

The paper firstly discusses the basic eliciting conditions of interest, drawing from emotion psychology and the empirical arts. Next, the aim of the study is stated: demonstrating the central role of the appraisal dimension 'coping potential' for experiencing usage-interest. Two hypotheses regarding the eliciting conditions of interest in human-product interaction are formulated. The paper reports on two workshops that generated an understanding of how knowledge of these basic eliciting conditions can be used to design an interesting interaction. The insights gained were subsequently used for designing interactive prototypes that served as stimuli in the main study in which appraisal components of interest and emotions were measured. By providing an example of how to design for a specific positive emotion, this paper can serve as an example of how products can be designed to evoke experiences that are differentiated beyond the basic pleasure-displeasure dimension.

## Studies of Interest in Empirical Art

Interest is an emotion type that represents experiences like fascination, curiosity, intrigue, excitement and wonder, and shares a conceptual space with challenge and intrinsic motivation (Deci & Ryan, 1985). Interest arises in contexts considered as safe as well as offering novelty, change and a sense of possibility or mystery (Izard, 1977). These contexts are apt to require attention and endeavor (Fredrickson, 1998). It is important to note that some theorists do not consider interest to be an emotion (e.g., Ortony, Clore, & Collins, 1988). We adhere to Silvia (2005), who showed that interest has all the characteristics that distinguish emotional from non-emotional states (as discussed by Lazarus, 1991); experience of interest involves facial and vocal expressions, pattern of cognitive appraisals, subjective experience and behavioral modification.

In the domain of art, empirical studies report on the relationship between the experience of interest and the qualities of art. A number of researches suggest that the stimulus properties of novelty, complexity, uncertainty or conflict induce interest. For example, Berlyne (1971) demonstrated that these qualities had a positive effect on experience of interest with experiments in which participants were exposed to sequences of colored shapes. The participants' feelings of interest increased with increasing stimulus novelty and complexity. Along with novelty, the provision of information is known to affect interest when people appreciate a piece of art. Russell and Miline (1997) investigated the effect of titles on the interest experience by presenting reproductions of paintings accompanied by the real titles, fake titles, or no titles. Participants evaluated the condition with real titles as most interesting. Russell (2003) compared the effects of titles and detailed descriptions of paintings. He found that respondents who read a paragraph describing an artist's work and its relevance to the painting judged the painting as more interesting and enjoyable than those who received no information. Jakesch and Leder (2009) studied the interplay of information quality on interest arousal. They tested interestingness by analyzing the number of matching and non-matching information with artworks. Participants were presented abstract artworks with several explanatory statements and were asked to indicate whether the statements corresponded with the artworks in order to test if the amount of perceived coherent (or dissonant) information, the number of explanatory statements, or a certain proportion of matching and non-matching information affects degree of interest. The results indicated that artworks with a moderate amount of coherent and dissonant information were most interesting over fully coherent or fully dissonant information.

Silvia (2005) conducted experiments that tested appraisal predictions about interest in poetry and visual art. An appraisal is an evaluation of the significance of a stimulus for one's personal well-being (Frijda, 1986). A central proposition of appraisal theory is that different emotions are evoked by different appraisals (Lazarus, 1991; Roseman & Smith, 2001; Scherer, Schorr, & Johnstone, 2001). Silvia (2005) demonstrated that the appraisal that evokes interest consists of two main components: novelty-complexity and coping-potential. Novelty-complexity is the degree to which one appraises an event as new, unexpected, complex, hard to process, mysterious, or obscure. Coping-potential is the degree to which one appraises oneself to have sufficient skills, knowledge and resources to deal with an event. He showed that both components are required in order to experience interest in experiments with random polygons, visual art and poetry. Furthermore, he found that this appraisal structure was specific to interest; it did not predict other positive

**JungKyoon Yoon** is a Ph.D. candidate in the Design Aesthetics group of Industrial Design Engineering at Delft University of Technology. In 2010, he received a Master of Science degree in Design for Interaction at the same university with a thesis entitled 'Experience of Interest in Human-Product Interactions.' He previously worked as a user experience designer at NHN where he supported the development of a search portal service and online-community services. His research focuses on the role of positive emotions in human-product interactions and subjective well-being, mainly concerning how positive emotions can contribute to enriching product experiences. Yoon is currently working on identifying underlying eliciting conditions and manifestations of positive emotions, and translating these into product design strategies.

Dr. **Pieter Desmet** is an associate professor of emotional design at the Faculty of Industrial Design Engineering at Delft University of Technology. His main research interest is in the field of design, emotion and subjective well-being. In cooperation with several international companies, he develops tools and methods that facilitate emotion and well-being-driven design. Desmet is board member of the International Design for Emotion Society and co-founder of the Delft Institute of Positive Design. In addition, he is involved in local community projects, like a recently developed floating wellness neighbourhood park, and a cultural Rotterdam-based 'house of happiness.' His latest book (co-edited with Dr. Schifferstein), *From Floating Wheelchairs to Mobile Car Parks*, presents a collection of 35 experience-driven design projects.

**Aadjan van der Helm** is a lecturer and researcher of interaction design at the IDStudiolab, a design research community of Industrial Design Engineering at Delft University of Technology. He organizes and teaches various courses on interaction design for interactive products and interactive environments. His main research interest is the development of digital technology that is accessible to end-users; he considers his educational activities as a main driver for this research. He develops tools and methods that enable designers to involve digital technology in the design process as a means to simulate design ideas and reflect on the qualities of these ideas. He has authored several publications in this field. He coordinates the day-to-day operation of the IDStudiolab, providing an inspiring environment for the multi disciplinary activity of design research.

emotions such as enjoyment. These findings are in line with the assumption of appraisal theory that each emotion has a unique appraisal structure (Roseman & Smith, 2001; Scherer et al., 2001). Silvia's approach is particularly interesting for the purpose of the current paper because it both elucidates the underlying principles of interest experiences and proves that the appraisal perspective offers a way of construing the causes of discrete emotions. Although Jakesch and Leder (2009), Russell (2003), Russell and Miline (1997), and Berlyne (1971) unveil various aspects of interest, their theory does not account for the difference of eliciting conditions and functions between interest and other similar positive emotions. It was therefore decided to use the two appraisal components proposed by Silvia as the basis for developing an interesting human-product interaction.

However, for two reasons, the appraisal components proposed by Silvia are not directly applicable to product design. The first is that his work focused on abstract stimuli such as simple polygons. It is therefore not clear how these findings can be translated to the holistic and complex design of consumer products. Furthermore, the stimuli did not involve physical interactions where the focus of the current study is on human-product interaction. Therefore, using a research-through-design approach, we explored how to use the general appraisal components underlying interest as the basis for designing interactive products.

## Research Aim and Hypotheses

We decided to focus on the role of coping potential because the role of novelty-complexity has been explored in various previous design case studies. For instance, Grimaldi's (2008) Ta-da project demonstrated that odd shapes or details of the objects elicit interest, attract the attention and invite the user to interact with them. In terms of the impact of coping potential on arousal of interest in interaction, we hypothesized that both novelty and coping potential are required for experiencing interest. This implies that we expect to demonstrate that novelty is not sufficient for the experience of interest. When the product is appraised as novel, but there is low coping potential, the product will not be interesting, which was operationalized in the following hypotheses. For a product that is appraised as novel:

- H1: If the users appraise high novelty and high coping potential, they will experience interest.
- H2: If the users appraise high novelty and low coping potential, they will experience unpleasant emotions, such as, annoyance or frustration.

### Stage 1: Developing Stimuli

To test the hypotheses, we decided to develop three prototypes of an interactive music player to serve as stimuli in an experiment. Since this study focuses on interest in human-product interaction, the design requirements were that the prototypes should be identical in terms of appearance and functionalities, which means that a user should not recognize any difference among three prototypes before using them. In physical interaction, however, they should vary in terms of the degree of interest. While a user interacts with a prototype, the degree of appraised novelty-complexity should be equal, but the degree of appraised coping potential should differ: high, versus neutral, versus low coping potential.

It was required to have an understanding of how interest appraisals can be used to design an interesting interaction to develop effective stimuli. For this, two workshops were organized. The first workshop explored how people experience interest while using a product, primarily focusing on what specific questions underlie in appraisals of novelty-complexity and coping potential. The second workshop explored the design implications of the underlying questions of interest appraisals.

### Workshop 1: Interest in Human-Product Interaction

In the first workshop, three music players were used: one that was very interesting, one that was neutral and one that was uninteresting. To select these three products, the first author collected thirty pictures of interactive music players and positioned them in two dimensional interest-space (X-axis: coping potential appraisal, Y-axis: novelty-complexity appraisal). The positioning was based on a holistic consideration of product properties such as form, functional complexity and ease of use. Three models that were expected to vary in terms of the two appraisal dimensions were selected: Apple iPod shuffle (very interesting), Apple iPod classic (neutral), MPX-ione (uninteresting).

Nine industrial design master students participated individually. The three MP3 players were handed to them in random order. The task was to try the product without being provided with additional instructions or information. The participants were instructed to voice their thoughts while exploring the product. The aim of this procedure was to observe what kinds of questions were related to the two appraisal dimensions underlying interest. After using all three products, the session ended with an interview in which the participants talked about the features of the products they discovered, feelings during use, challenging moments and how they coped.

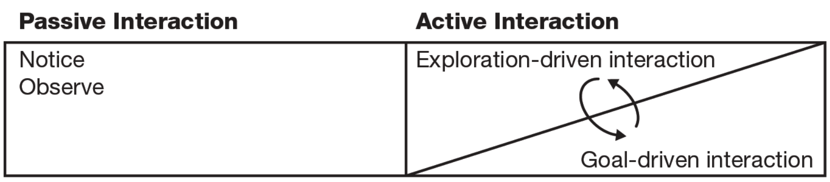
The analysis focused on the moments in which the participants experienced interest and on the aspects of the product that were attributed to the interest. It was observed that appraisal questions can be broken down to a set of subordinate questions. For the novelty-complexity appraisal, the super ordinate question is: "Is this novel or complex?" For user-product interaction, this involves several subordinate questions that are more detailed and stimulus related. Examples that were found in this workshop are: "Can I identify what the product is?"; "Can I identify how to activate a certain function?" When the answer of any of these questions was 'no', the stimulus was appraised as novel or complex. The collected questions related to novelty-complexity and coping potential appraisal were clustered according to similarity and reformulated to a set of subordinate questions (see Figure 1). Interest was experienced in two stages of use:

**Subordinate questions in exploration-driven interaction**

**Coping potential appraisal**
Confidence
- Is it safe to touch?
- Can I avoid damaging it?
- Do I have enough skills or knowledge to handle it?

Versatility
- Can I inadvertently use or handle it?
- Is there anything that I can do with the product except for using main features of it?

**Novelty-complexity appraisal**
Uniqueness in handling the product
- Do I know how to handle it?




**Subordinate questions in passive interaction**

**Coping potential appraisal**
Confidence
- Is it safe to touch?
- Can I avoid damaging it?
- Do I have enough skills or knowledge to handle it?

**Novelty-complexity appraisal**
Understandability about the identity of a product
- Can I identify what it is?
- Can I identify what the purpose of it?
- Do I know what I can do with it?

**Subordinate questions in goal-driven interaction**

**Coping potential appraisal**
Understandability of the product identity
- Can I identify it?
- Can I identify the purpose of it?
- Can I identify what I can do with it?

Confidence
- Is it safe to touch?
- Can I avoid damaging it?
- Do I have enough skills or knowledge to handle it?

Convenient operation
- Can I effortlessly operate it?

**Novelty-complexity appraisal**
Uncertainty in the way of operation
- Can I identify how to operate certain features of it?

**Figure 1. Framework of use stages and subordinate appraisal questions.**
Experience of interest was found in two stages of interaction: passive interaction and active interaction.

(1) when participants noticed or observed the products and (2) when they actually explored and used the products. We labeled these stages as passive interaction and active interaction. Figure 1 visualizes the experiences of interest and underlying subordinate appraisal questions for the passive and active interaction.

Passive interaction is the interaction where one notices or observes a product (aspect) without being in physical contact with it. The participants felt interest when the identity of the product was opaque, but they were sure that it was safe to explore and they believed that they had enough knowledge and skills to handle it. Active interaction involves physical contact and takes place during actual product use. This involves two types of interaction: exploration-driven and goal-driven interaction. These two types of interaction are not explicitly distinguishable, but iteratively take place. For example, when a participant tried out a product, he first explored it, then he subsequently thought: "Perhaps, I can skip the song" and he started looking for that functionality changing from exploration-driven to goal-driven interaction. Interest in exploration-driven interaction was observed when a certain level of motor skill to handle the product was required and the participants tended to play with the products, enjoying challenges caused by the reaction of the product (e.g., change in shape, center of gravity, orientation, etc.). In the case of goal-driven interaction, once the participants clearly understood the identity of the product, they tended to infer the possible functions and started to explore the product to establish if the product actually has that function and how to activate it. Each interaction type involved different set of subordinate appraisal questions (see Figure 1).

## Workshop 2: Product Design Implications

The second workshop was conducted to generate an understanding of how the collected subordinate appraisal questions can be used to design a product that evokes interest. Six master students from the Faculty of Industrial Design Engineering at Delft University of Technology participated. The workshop consisted of three phases: sensitizing, designing and discussing. The sensitization phase was designed to communicate the findings of the first workshop and to stimulate the participants' general awareness of the meaning of interest. Each participant presented a product (selected from the category of consumer electronics) that they found interesting and shared why it had been interesting to him or her. They were then provided with a definition of interest and general eliciting conditions to discuss why the product was interesting. The aim of this procedure was to generate a common perspective on the concept of interest.

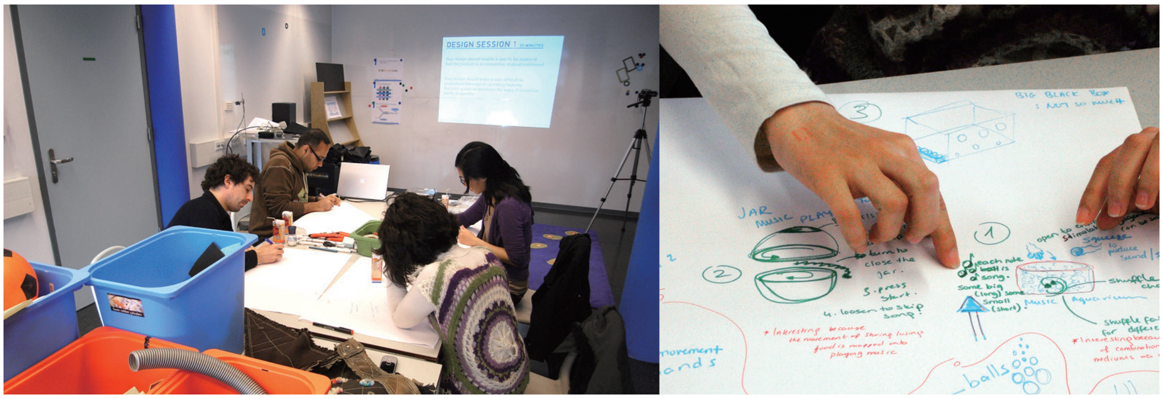



**Figure 2. Design workshop and an example of generated concepts.**

In the design session, the participants generated concepts of an interactive music instrument. In line with the findings of the first workshop, the design session was composed of three parts: designing for the experience of interest in passive interaction, goal-driven interaction and exploration-driven interaction. For each part, the designers were instructed to explicitly satisfy the subordinate appraisal questions described in Figure 1 as design requirements. At the end of each session, the participants explained how they fulfilled the design requirements in their creative process.

A total of 63 concepts were collected. The participants were interviewed to identify their strategies and the related product aspects. The framework of physical product interaction proposed by Klooster and Overbeeke (2005) and Locher, Overbeeke, and Wensveen (2010) were used as a structure of the interview: appearance (shape, color, proposition, size), force (strength, weight, pressure), motion (fast, slow, long, short) and textures (smooth, rough, soft, prick). The applied design strategies were grouped according to the similarities and translated into 19 general strategies. This approach sought insights into how a product can be designed to affect a user's appraisals in terms of novelty and coping potential. Design strategies for novelty-complexity appraisal mainly address challenges or disconfirmation of expectations in interactions and strategies for coping potential appraisal concern assuring a user to be confident in interactions. An example of a strategy for 'confidence in approaching' is to add a playful and symbolic feature. In many concepts, it was observed that a decorative handle was nestled in a music player although the handle was not meant to make it portable. This approach was used to invite those who are not comfortable with technology or an unfamiliar object to touch and try it. Another example associated with 'convenience of operation' is to use supportive reactions of a product. In many concepts, supportive reactions in response to a user's bodily movements or gestures were used as a way to reduce the user's endeavor (e.g., a self-right doll-shaped percussion instrument that supports a user to easily repeat stroking). Table 1 describes the design strategies according to the subordinate questions of each appraisal dimension. A detailed description of the design strategies and examples can be found in Yoon (2010). The collected strategies were used as a guideline for designing the experiential prototype for the main study.

**Table 1. Design strategies for affecting a user's appraisals.**

| Interaction stages | Novelty-complexity appraisal | Coping potential appraisal |
|---|---|---|
| Passive interaction | **Identification of the product (part)**<br>• Unconventional appearance.<br>• New material with unknown characteristics.<br>• Discrepancy between appearance and actual identity of the product that impairs users' association.<br>• Minimalized design elements (e.g. the composition of simple geometrical figures).<br>• Additional feature that looks irrelevant with the main function of the product. | **Confidence in approaching the product**<br>• Playful and symbolic feature than functional that invites a user to try the product.<br>• Flexible (or durable) material that can afford dynamic activities in use.<br>• Use of metaphors in appearance that enables inferences drawn from related experience or memory such as trial of other objects.<br>• Stable structure (or composition of components). |
| Active interaction | **The way of operating the product**<br>• Sophisticated method that involves combinations of dynamic actions.<br>• Implicit visual feedback that requires interpretation in response to a user's action.<br>• Multi-sensory feedback.<br><br>**Challenge in handling the product**<br>• Randomized reactions toward a user's action.<br>• Component of a product that has unbalanced structure. | **Convenient operation in use**<br>• Supportive reactions of a product in response to a user's actions aiming to reduce fatigue in interaction.<br>• Metaphoric motions that a user can habitually perform without cognitive effort (motions that are performed in everyday life such as shaking hands, opening a drawer, etc.).<br>• Actions that are performed for using similar product types .<br>**Versatile usage**<br>• Modularity that enables to personalize the product that matches a user's preference.<br>• Appearance that give various action possibilities. |

## Designing an Interactive Music Player

A series of designs were developed and tested. Figure 3 illustrates two initial concepts and their lo-fi prototypes. Concept 1 consists of a speaker, a wheel button and a board on which the visual information is projected. A user controls functions by rotating and pressing the wheel button placed behind the speaker. Concept 2 is composed of two speakers, a button and a LED track indicator. Users can change songs by pressing the left or right side. Electromagnets are placed under the two buttons and these affect the quality of interactions by changing its polarity; it sticks or repels the bottom side according to the setting of the electromagnets. The second concept was selected for elaboration because it was more effective to differentiate the degree of coping potential appraisal in interaction. The expected effects of manipulation in the first concept are too subtle and visual interaction was dominantly applied.

Three variants of lo-fi physical prototypes were built to examine if manipulating product attributes could actually affect the coping potential appraisal. In Prototype A, two permanent magnets inside the previous and next buttons, which exhibit the same polarity, are attached to keep repelling the bottom side. Once a user presses a button, it immediately moves back to its previous position due to the magnetic effect. This mechanism intends to support the user to easily change tracks. Prototype B operates without magnet intervention. When a user presses a button, they need to find a balance to press it again. In Prototype C, two permanent magnets with reversed polarity are attached to make the button and the bottom side stick together. This setting makes it very awkward to find a balance and press a button again. The prototypes were pre-tested with nine master students from the Faculty of Industrial Design Engineering at Delft University of Technology; the qualities of interaction were further elaborated to clearly differentiate the level of perceived coping potential.

### Final Design of Interactive Music Player

The prototypes were developed further as interactive hi-fi prototypes with complete functionality. The music player consists of a wooden container, a bar, a speaker, LEDs and two electromagnets. The electronic components are housed inside the wooden container (see Figure 4). The bar is for switching on/off, changing songs and controlling volume range. The three prototypes share the same hardware compartments and, accordingly, the outward form of the three prototypes is exactly the same. In addition to the appearance, the way of operation is the same for all three prototypes to make them be perceived as evenly novel. However, by controlling the software the qualities of interaction are differentiated to vary the level of coping potential. The setting of electromagnets and LEDs were programmed for manipulation of interaction qualities. For a demonstration movie visit http://vimeo.com/18850757.

### Interaction Scenario

For the three variants, there is no difference in terms of interaction qualities for turning on the music player and controlling the volume. A user can switch on the music player by turning the bar clockwise. When the bar passes a certain point marked on the top surface, the music player starts playing the first track. Once the music player is on, the volume is on the minimum level. By turning the bar clockwise, a user can increase the volume.

Interaction qualities were differentiated for using two functions: changing songs and reading the track number. A user can get the next or previous song by pressing down the poles of the bar. The left side is the previous button and the next button is on the right side. In case of Prototype A, when the button is pressed an electromagnet inside the container attracts the bar and repels it to automatically place the bar on the neutral point. There is no magnet intervention for Prototype B. The user needs to balance the bar to press the button again. Once the button of

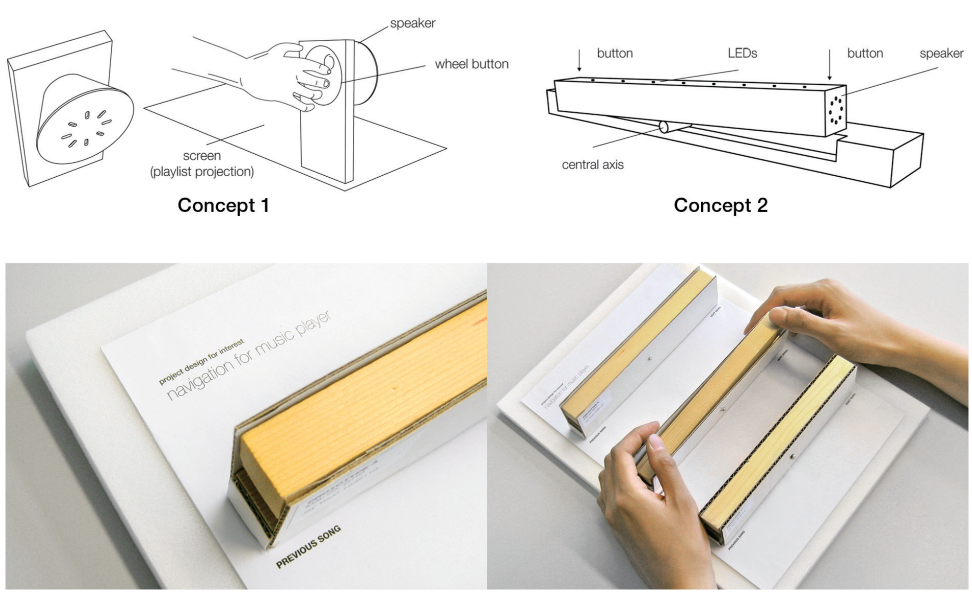



**Figure 3. Two initial design concepts and lo-fi prototypes for the development of the stimuli for the main study.**

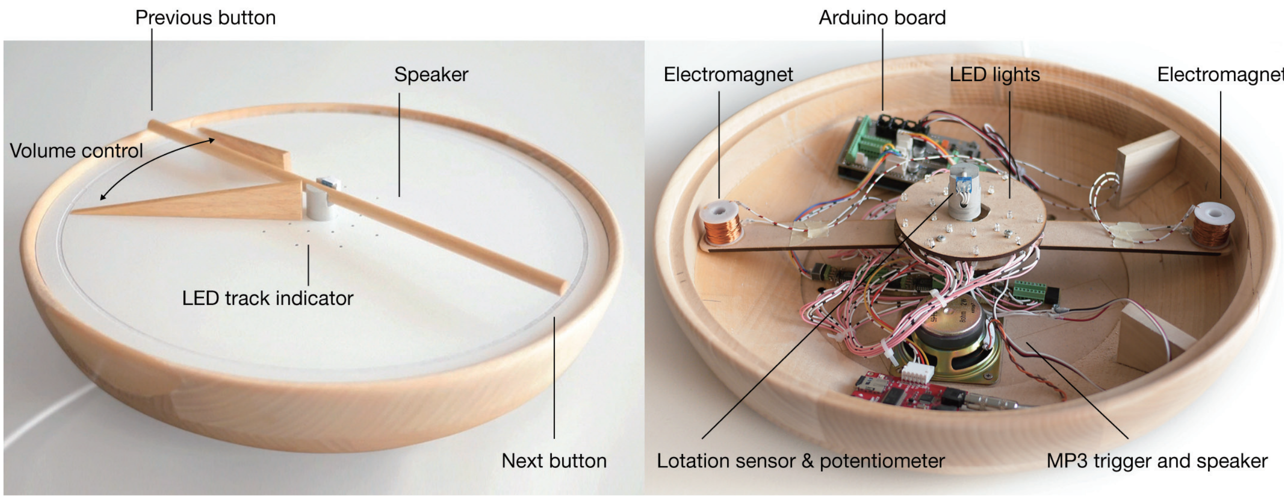



**Figure 4. Final design of the prototype (interactive music player) for the main study.**

Prototype C is pressed, it sticks to the bottom side due to the effect of an electromagnet and the user has to carefully detach it to find the balance because two electromagnets inside the prototype constantly attract both sides. When a song is over, the next song is played automatically. In case of prototype A, the right side of the bar hits the top surface of the container and bounces back when the song changes. This movement is designed to demonstrate to a user how to skip songs. Prototype B and C do not have this feature. Reading the track number is the only valid way for the user of Prototype A and B. Eighteen LEDs under the holes indicate the track number.

## Stage 2: Main Study

The emotional states of the participants were measured before and after use of the three prototypes with self-reports and behavioral observations. The collected data was analyzed to investigate the effects of manipulated interaction qualities on the experience of interest.

### *Stimuli*

The stimuli were three prototypes of an interactive music player. Non-lyrical songs, which take no longer than 10 seconds, were collected and randomly mixed in the play list. Unfamiliar non-lyrical songs were used to minimize the influence of the music on the level of interest and to avoid the participants favouring certain songs without interacting with the prototypes.

### *Experiment Setting and Questionnaire*

The experiment was conducted in a neutral laboratory room. A folding screen divided the room into two spaces. By placing the prototype behind the screen, it was not exposed to the participants when they entered the room. This layout ensured that interest experiences only began when the respondent started using the prototype.

A questionnaire was used that was composed of three parts. In each part, questions were presented with a 7-point scale with the verbal anchors of disagree and agree. The first part was administered before using the prototype. It included questions that measured the interest level experienced during passive interaction. The questions referred to both cognitive and behavioral effects of interest. The second and third parts were administered after using the prototype. The second part measured the appraisal of novelty-complexity and coping potential. In this part, the questions were adapted from the subordinate questions of interest appraisal found in the first workshop. The questions in the third part measured the level of interest and other emotional responses in active interaction. The data collected from the second and third parts of the questionnaire were used to assess how differentiated level of coping potential appraisal affects interest ($H_1$) and other emotions ($H_2$). Table 2 describes the questionnaire items. To prevent biased results caused by respondents guessing the aim of the study, additional questions were added in each part of the questionnaire. These were questions about aesthetic qualities of the prototype, such as “the form of this product is appealing”, “this product looks valuable”, “this product looks professional”, etc. The order of the questions was randomized. Results generated with questions to aesthetic qualities were not analyzed.

## Pilot Test

A pilot test was carried out to test the procedure.

### *Participants*

Twenty-five individuals (17 women) participated. The sample’s mean age was 24 years (min. = 19, max. = 36). The participants were students and employees of the Faculty of Industrial Design Engineering at Delft University. They received no compensation for their participation. Due to the intricacy of the experiment, data from two participants was ruled out.

**Table 2. Questionnaire items used in the main study.**

| Part | Questions | |
|---|---|---|
| Questionnaire Part 1 | • I think this product is boring.<br>• This product makes me feel curious.<br>• I wonder what I can do with this product.<br>• This product is fascinating. | • I am interested in this product.<br>• I want to know more about this product.<br>• I am indifferent to this product.<br>• I am eager to explore this product. |
| Questionnaire Part 2 | • The product was mysterious when I first explored it.<br>• I have never seen this kind of interaction for playing music before.<br>• I did not expect that this is a music player.<br>• This is a stereotype of a music player.<br>• I thought the way of playing music is new and distinct compared to other music players.<br>• I could immediately figure out how to control this product. | • I was confident of that this product would not harm me.<br>• I could get a sense of what I can achieve by using this product.<br>• I felt being in control while using this product.<br>• I worried about damaging this product.<br>• I could identify what I can do with this product.<br>• I could effortlessly operate this product.<br>• I could change the status of this product as I intended. |
| Questionnaire Part 3 | • I thought this product is boring while using it (reverse score).<br>• This product made me feel curious while using it.<br>• This product motivated me to continuously interact with it.<br>• I was indifferent to use this product (reverse score).<br>• This product is fascinating.<br>• I was eager to explore this product. | • I found myself actively using this product.<br>• I was interested in this product.<br>• I was frustrated while using the product.<br>• There were annoying moments while using this product.<br>• I experienced anxiety while interacting with this product.<br>• I was disappointed with this product. |

### *Procedure*

A between-subjects design was used; participants were divided into three groups and a different prototype was assigned to each group. The experiment was performed individually in two stages. In the first stage, the participant was guided to the prototype and asked to observe it. In this stage, physical interaction with the prototype was not allowed. Next, questionnaire part 1 was filled out. In the second stage, the participant was instructed to use the prototype. There was no time limitation and the facilitator did not intervene in the usage stage. After using the prototype, the respondents were interviewed about the features of the prototype that they discovered and how they felt during and about use. After the interview, questionnaire parts 2 and 3 were filled out. The procedure took 30 minutes per participant and all procedures were video recorded.

### *Results of the Pilot Test*

Scores of the measured concepts were calculated by averaging the respective item values. The internal consistency reliability of interest, coping potential and novelty-complexity were sufficient [Cronbach's alpha on the pooled values: interest in passive interaction $\alpha = .74$, coping potential $\alpha = .70$, novelty-complexity $\alpha = .66$, interest in active interaction $\alpha = .81$].

Contrary to our expectations, a one-way between-subject ANOVA test did not indicate a significant effect of prototype on interest: $F(2,20) = .78$, $p = .47$. The level of coping potential was highest for Prototype A ($M = 5.20$). Prototype C followed ($M = 5.17$). The lowest level of coping potential ($M = 4.70$) was reported by the group who used Prototype B ($M = 4.70$).

### *Reflection on the Pilot Test*

The results indicate that Prototype C rated relatively high on the items "I could effortlessly operate this product" and "I could change the status of this product as I intended". The ratings on these two items increased the Prototype C's mean score of coping potential (see Figure 5). To understand why these two items were rated particularly high, interviews with participants and recorded video were analyzed. This analysis indicated that 4 (out of 6) participants who used Prototype C did not fully understand the features and tried fewer features because they had to discover features themselves and were not stimulated in doing so by a given interaction task. Consequently, it led them to set simpler interaction goals and the particular goal-driven interactions that were designed to decrease coping potential were not discovered. In other words, they thought they could cope simply because they did not discover the complex functionalities. More varied goal-driven interactions were observed in the groups who used Prototype A and B. These results can be explained with the findings of Hassenzahl (2001). Their study on the relation between pragmatic attributes and appeal showed that if participants were instructed to just "have fun or try" the product, pragmatic qualities were not examined and thus they were irrelevant to the overall evaluation of product appeal. Strong correlation between post-use ratings of pragmatic quality and appeal was found if the interaction was goal directed.

The results of the pilot showed that the research setup was not effective to observe the impact of coping potential appraisals on interest since the participants rarely experienced the goal-driven interactions in which the coping potential appraisals were manipulated so the ratings about interest were irrelevant to them. Therefore, we decided to use a within-

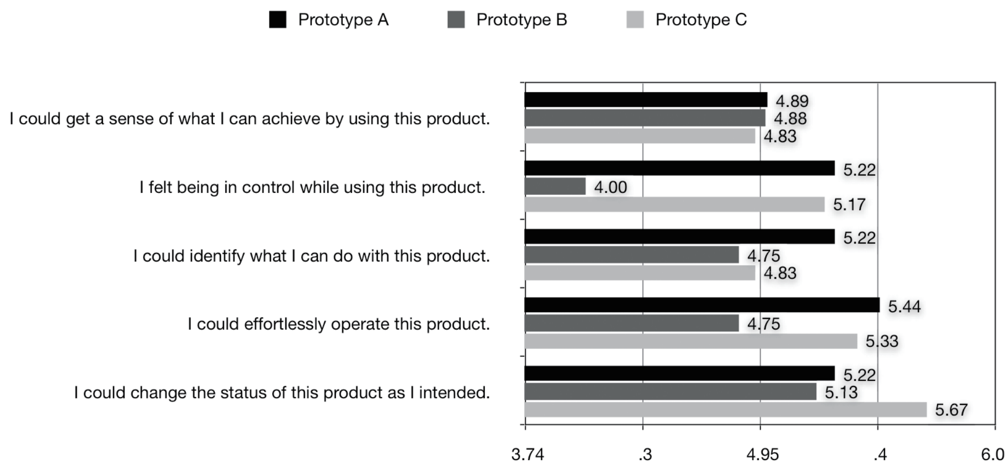



**Figure 5. Measured coping potential level in the pilot test for the main study.**

**Figure 6. Participants interacting with the prototype in the main study.**

subjects design for the main study. It was hypothesized that if a participant uses two different stimuli and compares them, the differentiated aspects of the stimuli will be clearly experienced. For this, Prototype A and C were selected as stimuli for the main study.

### Experiment – Main Study

#### *Participants*

The participants were 25 students (13 males) of industrial design engineering at Delft University of Technology, aged between 22 to 36 years (median = 26). They voluntarily joined the experiment. Data from two participants were excluded from the data analysis because these respondents misunderstood some questions due to their lack of English proficiency.

#### *Stimuli*

Prototype A and C served as stimuli.

#### *Procedure*

Participants were split into two groups. The first group used Prototype A first and then Prototype C. For the second group, this order was reversed. Participants were told that the prototypes have identical functions. This was done to stimulate them to try the same functions while using both prototypes, enabling them to explicitly experience the differences between the prototypes. No further details about the products were provided. Interest, other emotions and appraisals were measured with a questionnaire. Because viewing time is a valid behavioral indicator of interest (Renninger, Hidi, & Krapp, 1992), duration of use was also used as a behavioral measure for interest. For example, in Silvia's (2008) experiments viewing time was highest when both ability and complexity were at their highest values.

## Results and Discussion

The mean values for interest, coping potential and novelty-complexity were calculated by averaging the respective questionnaire item values per participant. The scores from the question "I could identify what I can do with this product", "I could get a sense of what I can achieve by using this product", "The product was mysterious when I first explored it", "I did not expect that this is a music player" were excluded because these items were not meaningful in the within-subject design. The internal consistency was high [Cronbach's alpha on the pooled values: interest in passive interaction $\alpha$ = .78, coping potential $\alpha$ = .79, novelty-complexity $\alpha$ = .59, interest in active interaction $\alpha$ = .85] (see Table 3). Table 4 shows the mean values of the measured variables.

## Manipulation Check

A T-test indicated that in active interaction both prototypes evoked levels of the novelty-complexity appraisal that are significantly higher than the scale midpoint [Prototype A: $t$ (22) = 9.23, $p < .05$ / Prototype C: $t$ (22) = 6.36, $p < .05$]. In addition, prototype A evoked higher levels of coping potential than Prototype C. This difference was confirmed in a one-way within-subject ANOVA, which found a significant main effect of the prototype on coping potential: $F$ (1,22) = 18.60, $p < .01$, partial eta squared = .453.

## Level of Interest in Active Interaction

The level of interest in passive interaction was compared with interest in active interaction. For Prototype A, a repeated measures ANOVA did not find a significant effect of passive versus active interaction on the level of interest: $F$ (1, 21) = .05, $p$ = .83. For Prototype C, however, the level of interest dropped significantly: $F$ (1, 21) = 34.30, $p < .05$. As visualized in Figure 7, Prototype A was consistently interesting when participants observed and actually used it, while Prototype C was less interesting in active than in passive interaction.

A repeated measures ANOVA indicated that there were significant prototype effects and usage stages effect on interest level [prototype: $F$ (1,21) = 30.54, $p < .05$ / usage stage: $F$ (1,21) = 12.57, $p < .05$]. In addition, a significant prototype x usage stage interaction effect was found: $F$ (1,21) = 30.54, $p < .05$.

## Behavioural Manifestation of Interest: Usage Duration

The effect of prototype on usage duration was tested with a one-way within-subject ANOVA. Difference of usage duration between Prototype A and C was significant: $F$ (1,21) = 28.23, $p < .05$. Prototype A (average usage time = 221 seconds) was used longer than Prototype C (average usage time = 130 seconds). Significant correlations were found between usage duration and the level of interest: $r$ = .38, $p < .05$, and between usage duration and coping potential: $r$ = .30, $p < .05$ (see Table 5).

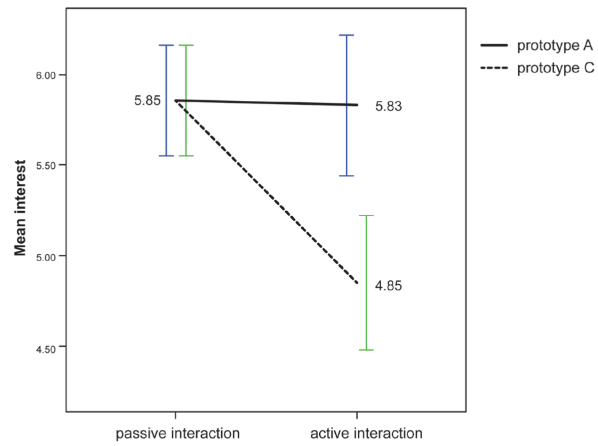


**Figure 7. Change of the level of interest in passive and active interaction C.** Error bars:*95% Confidence Intervals.*

## Role of Coping Potential for Eliciting Interest in Active Interaction

Two correlations were computed to examine the role of coping potential (see Table 6 and 7). The correlation between coping potential and interest was significant and stable across the prototypes with 7.74% variance [Prototype A: $r$ = .52, $p < .01$ / Prototype C: $r$ = .48, $p < .01$]. The strongest correlation for interest was with novelty-complexity [Prototype A: $r$ = .57, $p < .01$ / Prototype C: $r$ = .52, $p < .01$]. The variance between two prototypes was 8.74%. These results support H1.

**Table 3. Internal consistency of the question items in the questionnaire.**

| Variables | Cronbach's Alpha | Cronbach's Alpha Based on Standardized items | N of Items | N |
|---|---|---|---|---|
| Interest in passive interaction | .78 | .83 | 8 | 22 |
| Coping potential | .79 | .79 | 4 | 46 |
| Novelty-complexity | .59 | .60 | 4 | 46 |
| Interest in active interaction | .85 | .86 | 8 | 46 |

**Table 4. Mean values of the measured variables in the main study.**

| Prototype | Variables | Mean | Std. Deviation |
|---|---|---|---|
| Prototype A | Novelty-complexity | 5.89 | .98 |
| | Coping potential | 5.28 | 1.07 |
| | Interest in passive interaction | 5.85 | .68 |
| | Interest in active interaction | 5.83 | .89 |
| Prototype C | Novelty-complexity | 5.47 | 1.11 |
| | Coping potential | 4.01 | 1.11 |
| | Interest in passive interaction | 5.85 | .68 |
| | Interest in active interaction | 4.85 | .86 |

**Table 5. Correlations among duration of use, coping potential and interest level.**

| Variables | Coping potential | Interest in active interaction | Duration of use |
|---|---|---|---|
| Coping potential | 1 | 0.63** | 0.30* |
| Interest in Active interaction | 0.63** | 1 | 0.38* |
| Duration of use | 0.30* | 0.38* | 1 |

*NOTE:* ** Correlation is significant at the 0.01 level (2-tailed)* Correlation is significant at the 0.05 level (2-tailed).

**Table 6. Correlations among coping potential, novelty-complexity and interest level in Prototype A.**

| Variables | Coping potential | Novelty-complexity | Interest in active interaction |
|---|---|---|---|
| Coping potential | 1 | 0.16 | 0.52* |
| Novelty-complexity | 0.16 | 1 | 0.57** |
| Interest in active interaction | 0.52* | 0.57** | 1 |

*NOTE:* ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

**Table 7. Correlations among coping potential, novelty-complexity and interest level in Prototype C.**

| Variables | Coping potential | Novelty-complexity | Interest in active interaction |
|---|---|---|---|
| Coping potential | 1 | -0.04 | 0.48* |
| Novelty-complexity | 0.04 | 1 | 0.52** |
| Interest in active interaction | 0.48* | 0.52** | 1 |

*NOTE:* ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

## Absence of Coping Potential in Active Interaction

Various negative emotions were experienced during the experiment such as annoyance, anxiety, disappointment and frustration (see Figure 8). A repeated measures ANOVA indicated significant prototype effects on annoyance and disappointment: annoyance: $p$ = .03, disappointment: $p$ = .02. High levels of annoyance ($M$ = 4.78) and disappointment ($M$ = 3.78) were reported in response to Prototype C.

The strongest correlation was found between coping potential and annoyance: $r$ = -.68, $p$ < .01. The correlation between coping potential and disappointment was also significant: $r$ = -.52, $p$ < .01. Both annoyance and disappointment showed a negative correlation with interest [annoyance: $r$ = -.48, disappointment: $r$ = -.63]. The results support H2 and imply that given a product that is appraised as novel/complex, it is the appraised level of coping potential that differentiates between interest and anxiety or disappointment.

# Conclusion

The aim of this study was to test the causal role of coping potential appraisal for the experience of interest in active interactions. The underlying specific appraisal questions related to interest appraisals were extracted with workshops and these questions were translated into design strategies, which were then used to build experiential prototypes. Three variants of an interactive music player were designed to be equally novel, but different in terms of coping potential degree to demonstrate that novelty is not sufficient to evoke interest. The main study showed that

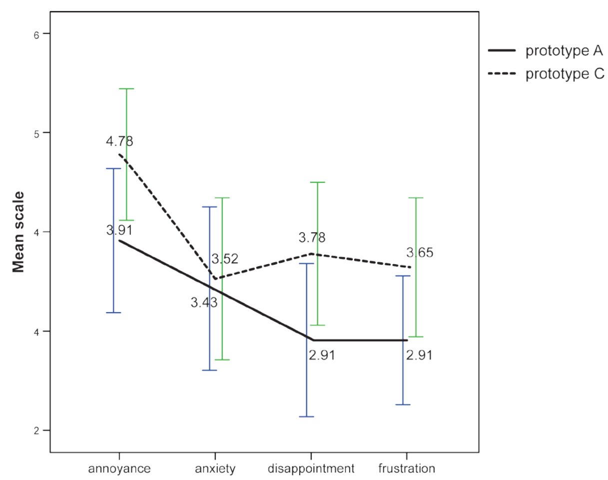



**Figure 8. Mean values of negative emotions experienced in active interaction.** *Error bars: 95% Confidence Intervals.*

**Table 8. Correlations among annoyance, disappointment, coping potential and interest.**

| Variables | Annoyance | Disappointment | Coping potential | Interest in active interaction |
|---|---|---|---|---|
| Annoyance | 1 | .48** | -.68** | -.48** |
| Disappointment | .48** | 1 | -.52** | -.63** |
| Coping potential | -.68** | -.52** | 1 | .63** |
| Interest in active interaction | -.48** | -.63** | .63** | 1 |

*NOTE:* **Correlation is significant at the 0.01 level (2-tailed).

an appraised coping potential is required for evoking interest. When the prototype provides high coping potential, the degree of interest was high. Participants reported that the more interesting the prototype, the more it motivated them to explore the product, to actively interact with it and to continue using it. Duration of use was longer when the participants were more interested in using the prototypes and the correlation between duration of use with coping potential was significant. Annoyance and disappointment were inversely linearly related to the degree of coping potential and interest. The results support the causal role of appraised coping potential in evoking user interest and imply that it is not sufficient to only include novel or complex features for product design. Making sure that the user has the ability to cope with the novelty or complexity is required. The study illustrates that it is possible to design interactions that intentionally influence users' appraisals, resulting in the elicitation of interest.

## General Discussion

This study explored whether it is possible to use appraisal theory to design an interaction that evokes a predefined and distinct positive emotion during human-product interaction. The results indicate that understanding the appraisal structure of an emotion can support designers to deliberately elicit an intended positive emotion. The approach presented in this paper can be a precedent in designing for other discrete positive emotions: (1) we investigated what specific subordinate questions were activated in interest appraisals and how they were associated with the usage stages; (2) the subordinate questions were used as a design guide to manipulate interactions. In turn, the prototype affected users' appraisals and the predefined emotion was elicited. This approach can assist designers to effectively manipulate appraisal components of other positive emotions. For example, designing for happiness can be approached by activating its appraisal components, motive consistency and certainty (Demir, Desmet, & Hekkert, 2009). This goal can be made more concrete by clarifying what specific subordinate questions underlie motive consistency and certainty appraisals during product usage and how they can be mapped on the framework of usage stages (see Figure 2). The framework of usage stages provides a structure for emotional design as it shows that each stage accompanies a different set of subordinate questions in appraisals. However, it is not yet validated whether the framework can be replicated to design for other positive emotions. With the help of more case studies that involve other product categories, we aim to validate and further refine the framework.

According to the emotion literature, interest is an important motivator to cultivate knowledge (Fredrickson, 1998; Isen, Daubman, & Nowicki, 1987; Renninger et al., 1992; Silvia, 2005). During the experiment, the cognitive effects of interest were not examined in detail. Since the prototypes were simple in terms of functions, the degree to which interest supports a user to better understand the prototype was not examined. Studying the effects of interest in a more comprehensive way requires more sophisticated stimuli. Another limiting aspect of this study is that the results are only based on momentary interactions. Participants used the prototypes once and their emotional responses were assessed based on their first impressions and the memories of first use. It would be an interesting additional step to investigate long-term emotional effects on use behavior and to test how long the impact will last when a user interacts with a product over time.

Note that designers should be aware that manipulating an appraisal component requires user research or users' involvement in the design process. For instance, designers cannot rely on themselves to understand users' coping potential because they can probably cope more easily since they are design professionals. Regarding the designer's high coping ability, we acknowledge that the participants in this study were not entirely representative in that the majority of them were design students. The fact that their coping-potential abilities for using products were probably relatively high may have influenced the results of the experiment. Note, however, that following this line of thought, one would expect that non-designers will report more rather than less differentiated coping-potential appraisals for the prototypes used in our study.

Levels of usability have been shown to strongly affect user emotions (Mahlke & Lindgaard, 2007; Mahlke, Minge, & Thüring, 2006; Thüring & Mahlke, 2007; Tractinsky & Zmiri, 2006). High usability evokes positive emotions, such as satisfaction and relaxation, and low usability evokes negative emotions, such as frustration, annoyance and anxiety (Mahlke et al., 2006; Tractinsky & Zmiri, 2006). What is interesting is that both appraisal components novelty and coping potential have also been shown to influence perceived usability. As is expected, low coping potential is associated with low usability, whereas high coping potential is associated with high usability. Alternatively, low novelty is associated with high usability and high novelty is associated with low usability (Mahlke et al., 2006). In other words, if a product is designed to be usable the user should appraise high coping potential and low novelty. The current study contrasts with this recommendation because it showed that high novelty can evoke positive instead of negative emotions. In the current study, the stimuli were manipulated to differ only in terms of coping potential and to be both high on novelty. By doing so, we found that high novelty can evoke positive emotions if it is combined with high coping potential. This means that the general recommendation to avoid novelty to stimulate usability should be modified. In fact, our study has shown that novelty as a variable (when and only when combined with high coping potential) can be used as a means to stimulate either high arousal positive emotions (e.g., interest, positive surprise in the case of high novelty) or low arousal positive emotions (e.g., relaxation and satisfaction in the case of low novelty, as was shown by Mahlke et al., 2006). This finding implies that there is not a direct relationship between usability and valence of experience. Sometimes low usability, through high levels of novelty, can indeed evoke positive emotions. It also means that high novelty does not necessarily evoke positive emotions; when coping potential is low, high novelty will evoke strong negative emotions.

The study also shows that novelty and coping potential are not dependent variables: something can be high on novelty and low on coping potential, or high on novelty and high on coping potential. They influence different qualities of users' emotion: coping potential influences the valence (i.e., high coping potential evokes positive emotions; low coping potential evokes negative emotions) whereas novelty influences arousal (i.e., high novelty evokes excited emotions; low novelty evokes calm emotions). This means that designers do not need to find a trade-off between these two components. Instead, novelty can be used as a means to decide on the type of emotion that is designed for: relaxed and satisfied versus interest and surprise.

The reality of design is much more nuanced and holistic than is captured by the 'appraisal formulas' this paper proposes. Our intention is to offer a source of inspiration for designers, a frame of thought that can help them to structure some of the complexity of their design challenges. In that sense, the appraisal formulas are not usable as a prescriptive design model or set of guidelines. We believe that the insights drawn from using the appraisal approach are mostly valuable for design education; design students can develop their design sensitivity by being exposed to available knowledge on all aspects of human-product interaction, including psychological principles. This knowledge will benefit from future studies in which design decisions that designers need to make when working with appraisal dimensions are studied, including, for example, trade-offs between the various appraisal dimensions. In general, our study indicates that there is a danger in treating appraisal components as independent 'design variables' because it is their combination rather than the individual appraisal components that determines the user experience.

## Acknowledgments

We would like to thank Rob Luxen for his work in building the prototypes. We would like to thank all participants for their contribution to the workshops and the main study. This research was supported by MAGW VIDI grant number 452-10-011 of The Netherlands Organization for Scientific Research (N.W.O.) awarded to P.M.A. Desmet.

## Reference

1. Berlyne, D. E. (1971). *Aesthetics and psychobiology.* New York, NY: Appleto-Century-Crofts.
2. Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.
3. Demir, E., Desmet, P. M. A., & Hekkert, P. (2009). Appraisal patterns of emotions in human-product interaction. *International Journal of Design*, 3(2), 41-51.
4. Desmet, P. M. A. (2002). *Designing emotions*. Delft, The Netherlands: Delft University of Technology.
5. Desmet, P. M. A. (2008). Product emotion. In H. N. J. Schifferstein & P. Hekkert (Eds.), *Product experience* (pp. 379 - 397). Amsterdam, The Netherlands: Elsevier.
6. Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology*, *2*(3), 300-319.
7. Fredrickson, B. L. (2003). The value of positive emotions: The emerging science of positive psychology is coming to understand why it's good to feel good. *American Scientist*, *91*(4), 330-335.
8. Fredrickson, B. L., & Losada, M. F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist*, *60*(7), 678-686.
9. Frijda, N. H. (1986). *The emotions*. Cambridge, UK: Cambridge University Press.
10. Grimaldi, S. (2008). The Ta-Da series – A technique for generating surprising designs based on opposites and gut reactions. In P. M. A. Desmet, J. van Erp, & M. Karlsson (Eds.), *Design and emotion moves* (pp. 165-188). Newcastle, UK: Cambridge Scholars Publishing.
11. Hassenzahl, M. (2001). The effect of perceived hedonic quality on product appealingness. *International Journal of Human-Computer Interaction*, *13*(4), 48 1-499.
12. Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52*(6), 1122-1131.
13. Izard, C. E. (1977). *Human emotions*. New York, NY: Plenum.
14. Jakesch, M., & Leder, H. (2009). Finding meaning in art: Preferred levels of ambiguity in art appreciation. *Quarterly Journal of Experimental Psychology*, *62*(11), 2105-2112.
15. Klooster, S., & Overbeeke, C. J. (2005) *Designing products as an integral part of choreography of interaction: The product's form as an integral part of movement*. In S. Kyffin, L. Feijs, & B. Young (Eds.), *Proceedings of the 1st European Workshop on Design and Semantics of Form and Movement* (pp. 23-35). Newcastle, UK: Northumbria University.
16. Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford, UK: Oxford University Press.
17. Locher, P., Overbeeke, K., & Wensveen, S. (2010). Aesthetic interaction: A framework. *Design Issues*, *26*(2), 70-79.
18. Mahlke, S., & Lindgaard, G. (2007). *Emotional experiences and quality perceptions of interactive products*. In J. A. Jacko (Ed.), *Proceedings of the 12th International Conference on Human-Computer Interaction* (pp. 164-173). London, UK: Springer.
19. Mahlke, S., Minge, M., & Thüring, M. (2006). Measuring multiple components of emotions in interactive contexts. In *Proceedings of the Conference on Human factors in Computing Systems* (Extended Abstracts, pp. 1061-1066). New York, NY: ACM Press.
20. Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotions*. Cambridge, UK: Cambridge University Press.
21. Renninger, K. A., Hidi, S., & Krapp, A. (1992). *The role of interest in learning and development*. Hillsdale, NJ: Erlbaum.
22. Richman, L. S., Kubzansky, L., Maselko, J., Kawach, I., Choo, P., & Bauer, M. (2005). Positive emotion and health:

Going beyond the negative. *Health Psychology*, *24*(4), 422-429.

23. Roseman, I. J., & Smith, G. A. (2001). Appraisal theory: Assumptions, varieties, controversies. In K. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods, research* (pp. 3-19). New York, NY: Oxford University Press.
24. Russell, P. A. (2003). Effort after meaning and the hedonic value of paintings. *British Journal of Psychology*, *94*(1), 99-110.
25. Russell, P. A., & Milne, S. (1997). Meaningfulness and the hedonic value of paintings: Effects of titles. *Empirical Studies of the Arts*, *15*(1), 61-73.
26. Scherer, K. R. (2005). What are emotions? And how can they be measured? *Social Science Information*, *44*(4), 695-729.
27. Scherer, K. R., Schorr, A., & Johnstone, T. (2001). *Appraisal processes in emotion: Theory, methods, research*. New York, NY: Oxford University Press.
28. Silvia, P. J. (2005). What is interesting? Exploring the appraisal structure of interest. *Emotion*, *5*(1), 89-102.
29. Silvia, P. J. (2008). Interest - The curious emotion. *Current Directions in Psychological Science*, *17*(1), 57-60.
30. Thüring, M., & Mahlke, S. (2007). Usability, aesthetics and emotions in human-technology interaction. *International Journal of Psychology*, *42*(4), 253-264.
31. Tractinsky, N., & Zmiri, D. (2006). Exploring attributes of skins as potential antecedents of emotion in HCI. In P. Fishwick (Ed.), *Aesthetic computing* (pp. 405-422). Cambridge, MA: MIT Press.
32. Yoon, J. (2010). *Experience of interest in human-product interaction* (Unpublished master's thesis). Delft University of Technology, Delft, The Netherlands.